

# Aerial Vehicle for Gulls' Nest Observation

SD1112

# Project Team

- **Members**
  - Lucas Brendel
  - Travis Hettwer
  - Aaron Olson
  - Breanna Schneider
- **Advisor**
  - Dr. Roger Green
- **Client**
  - Dr. Mark Clark and Dr. Wendy Reed of the Biological Sciences Department of NDSU

# The Problem

- Franklin's gulls are aquatic nesters
- Difficult to take an accurate and efficient census



Franklin's Gulls

# Project Requirements

- Design and construct an aerial vehicle equipped with a camera
- Obtain accurate census/nest information in an efficient manner
- Height: 100 ft – 150 ft



View of the Beaver Lake FRGU colony nesting area.

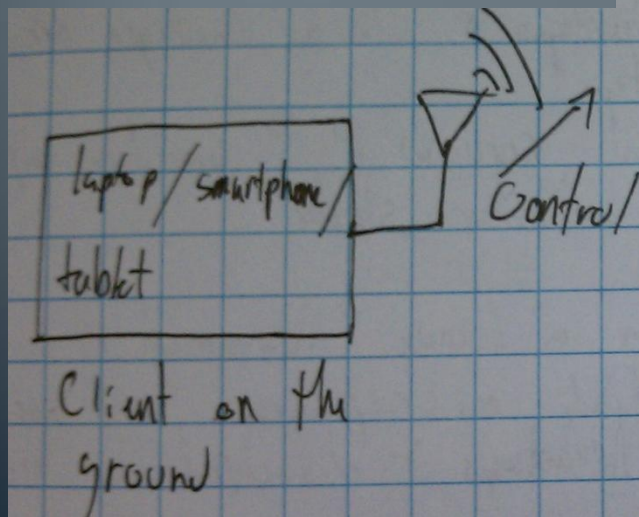
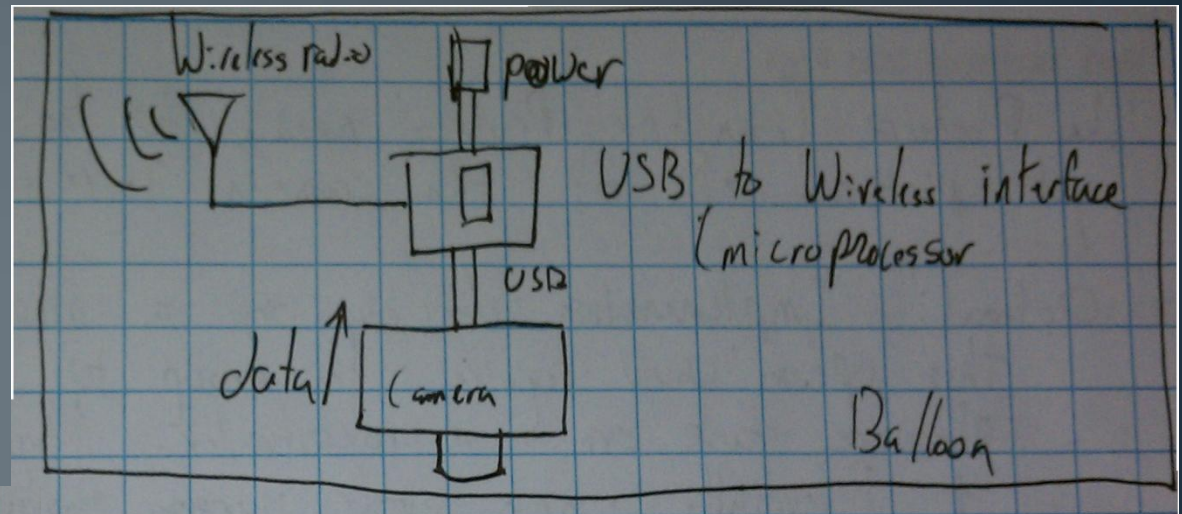


Aerial photo of JCS NWR from about 800'. Many FRGU nests are located in the cattail below.

# Options Considered

- Aerial Vehicles
  - Weather balloon
  - Kite
  - RC airplane
- Camera
  - Still versus video
- Communication
  - Wireless versus wired
- Image Processing
- GPS

# System Block Diagram



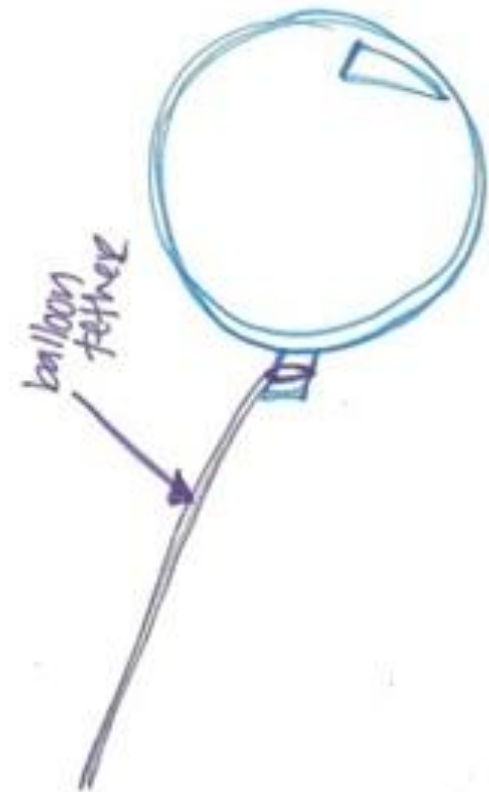
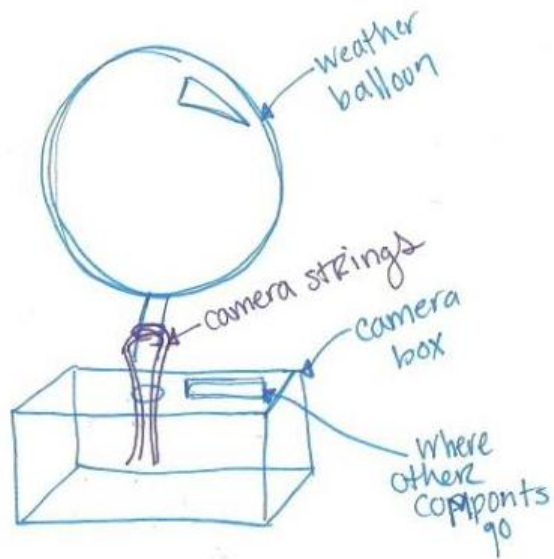


# Weather Balloon

- Specifications
  - 5.5 diameter
  - Chloroprene rubber
  - Maximum net lift: 4.6lbs
- Design Issues
  - Having a maximum net lift
  - Filling with helium is expensive
  - Susceptible to wind interference



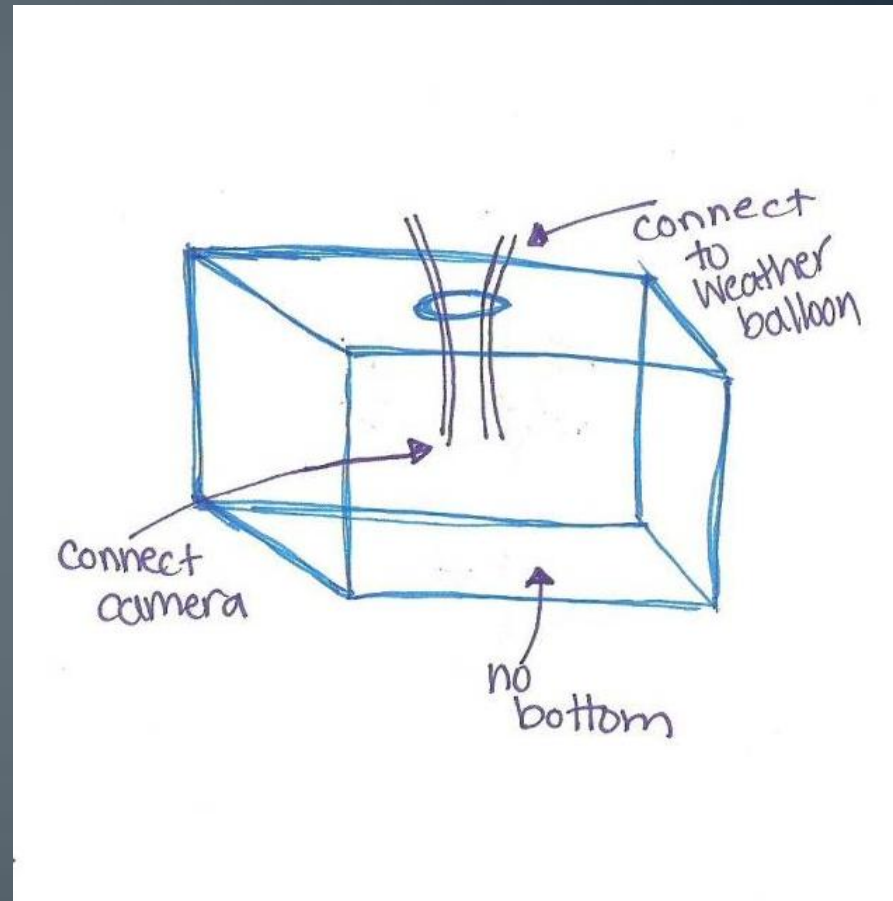
# Balloon Mount Ideas





# Camera Enclosure

- Made of plexi-glass
- Weight: 5 ounces



# Balloon Tether

- Solid braid nylon rope
- 1/8" diameter
- Tensile strength: 570 lbs
- Total weight of 1.7 lbs at 200 ft

# Helium

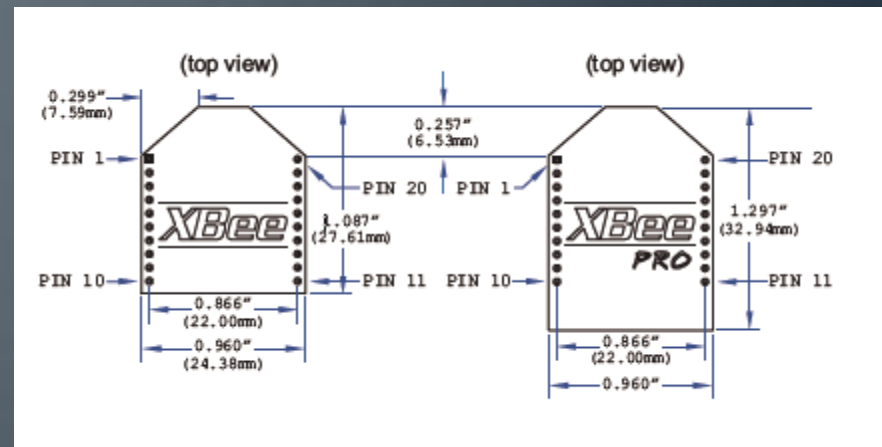
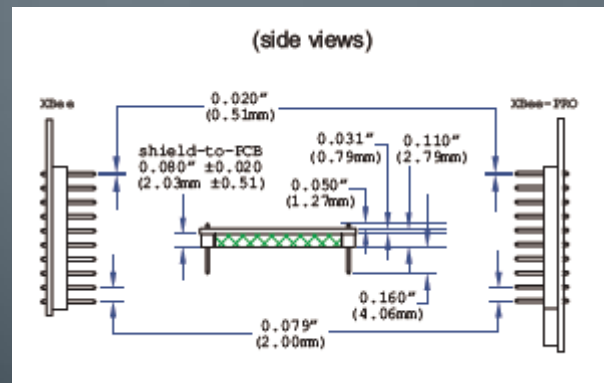
- Balloon is roughly 85 cubic feet
- Helium prices have tripled in the last five years
- Balloon doesn't need to be completely filled, lift capacity is related to helium
- Considered hydrogen, but it is unstable and hard to procure
- Other lighter-than-air gases are either toxic or highly flammable

# Camera

- Current Camera
  - Canon Power Shot SD870
    - 8.0 megapixels of resolution
    - 3.8x optical zooming
    - Runs CHDK (Cannon Hack Development Kit)
- Future Camera
  - Canon Power Shot S95
    - 10.0 megapixels of resolution
    - 3.8x optical zooming
    - Weight: 6 ounces
    - Runs CHDK

# XBee 802.15.4 (Series 1)

- Power requirements: 2.8 - 3.4VDC
- Outdoor/RF Line-of-Sight Range: 300ft



# Arduino Pro Mini

- Runs off 3.3 volts
- Weight: less than 2 grams
- Low-voltage board needs no interfacing circuitry to 3.3V devices and modules
- 8 MHz, 8 bit processor



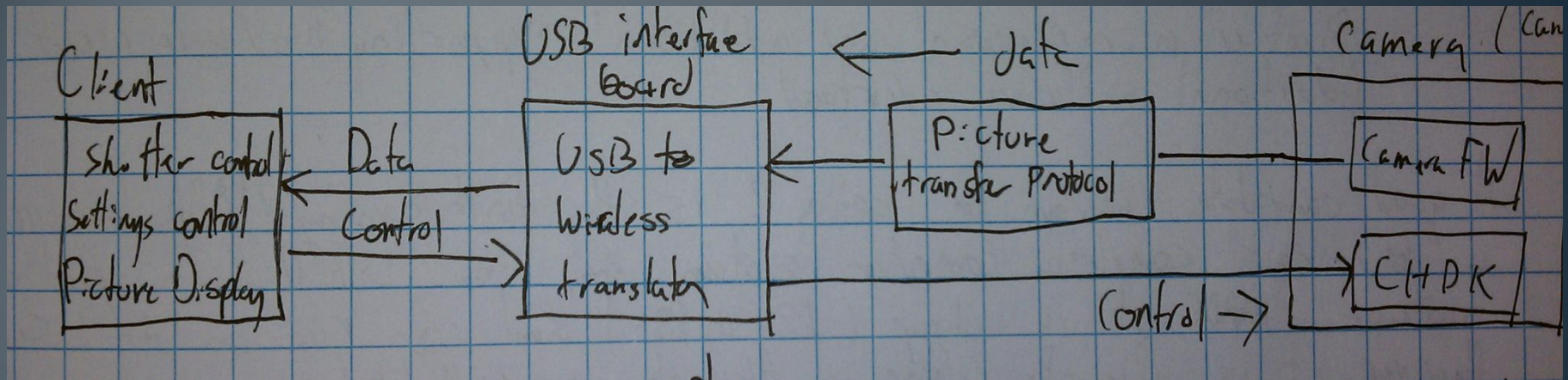


# USB Host Shield

- Allows Arduino to act as USB host
- Comes with software libraries for interfacing with generic USB devices and Picture Transfer Protocol



# Software Block Diagram

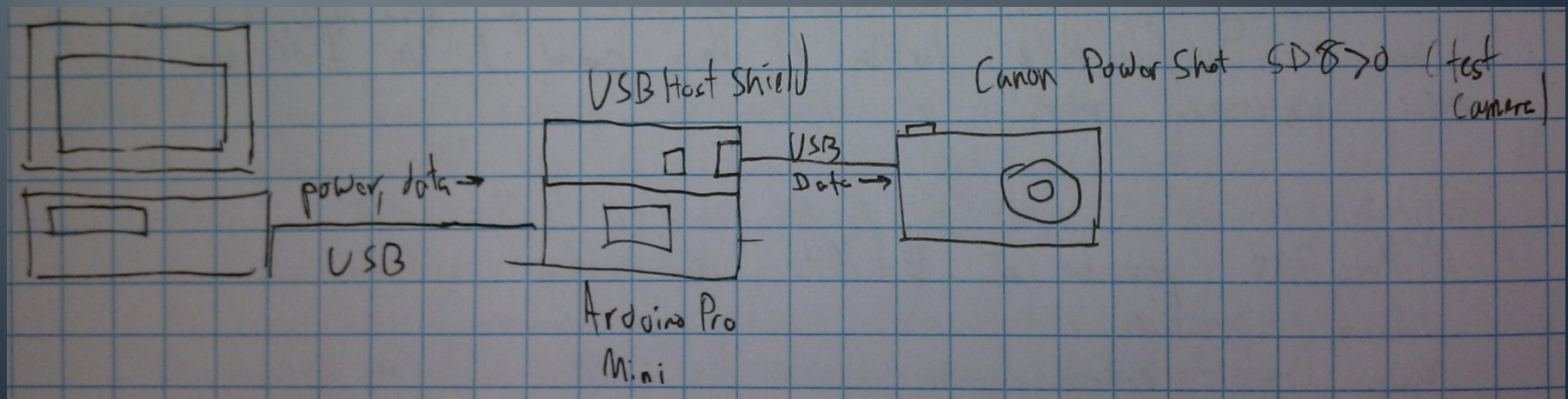


# Software – User Interface

- Interface built on Winform's C# platform
- Uses the Serial Communications class to communicate with Xbee board
- Intention to use the Aforge.NET image processing classes
- Creates a file in the user directory to store all pictures that are transmitted to the PC from the camera.
- Shows the most recent photo taken
- Can send commands to the camera to take pictures or zoom.

# Software – Camera Interface

- Uses the Picture Transfer Protocol (PTP) to interface with the camera over USB
- Our cameras do not support full PTP
- The Canon Hack Development Kit (CHDK) also interfaces with PTP and provides additional remote control functionality



# Current Purchases

Item	Price	Running Total
Weather Balloon	\$34	\$34
Wifi Antenna (Xbee)	\$25.95	\$59.95
Break-out Board	\$9	\$68.95
Arduino Board	\$42.63	\$111.58
USB adapter	\$20	\$138.58
Canon PowerShot SD870 IS	\$0(borrowing)	\$138.58
Plexiglass	\$0(acquired)	\$138.58
USB cables	\$0(borrowing)	\$138.58
Wire/Fishing Line	\$0(acquired)	\$138.58

# Future Purchases

Item	Price	Pending Total
Canon Power Shot S95	\$300	\$300
Balloon Tether	\$.22/ft * 200ft = \$44	\$344
Power Supply/Battery	\$20 - \$35	\$364 - \$379
PCB	\$40	\$404 - \$419
Helium	\$200	\$604 - \$619
Miscellaneous	\$30	\$634 - \$649

Current Purchases	\$138.58
Future Purchases	<u>+\$634 - \$649</u>
Total Budget	\$772.58 - \$787.58



# Conclusion

- Thank you for listening!